**THIN CLIENT COMPUTING**

**USING ANDROID WEB CLIENT**

**(FOR A SMALL SCHOOL HAVING 20 DESKTOPS)**

**BY**

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**EXECUTIVE SUMMARY**

While there is no single definition of Green IT, one inescapable truth is that for many organizations the IT department remains the largest consumer of [energy.](http://shop.bsigroup.com/en/Browse-by-Subject/Green-IT/) [[1]](#footnote-1)

It is imperative therefore that IT Professionals, practitioners must find ways to contribute to the global effort of reducing, electronic waste, lowering carbon emission and strive for energy efficiency while proving solutions to every business to become competitive and contribute to the effort of achieving sustainable and eco-friendly society.

The greatest barrier to adaption of “Sustainability in ICT” is the limited knowledge among different stakeholders and conflicting interest to adapt and integrate sustainability in ICT. While there are lot of initiatives reference to “Sustainability in ICT”, adaptation and implementation remains to be limited as it is primarily dominated by the “bottom-line” or the issue of profitability.

Global standards such as ISO 14001:2004 Environment, BS EN 16001:2009 Energy Management are adopted in Australia as well as AS/NZ 3598:2000

When all products claims to be energy efficient and compliant to standard why worry on carbon emissions and why bother check specifications and energy ratings? Are there any long term and short term tangible benefits that any business can be achieved to spend more time and effort to be “GREEN” when compliance to legislations and standards already made them profitable?

This paper aims to illustrate that apart from compliance to standards, IT Departments, Consultants, Practitioners can contribute further to any business become “Green, Sustainable and Profitable”. This also aims to illustrate that energy savings and monitoring is the first step towards “Green IT”.

To best illustrate the concept, this project will be implementing a 20 Web Client computer network and will be compared to 20 Desktop computer networks.

**The Project**

Small network with 20 web client computers connected to a server with attached printer and external backup drive.

**Objective**

1. Select energy efficient devices with low carbon emissions
2. Compare the calculated rating of the solution to the common solution, which is desktop computing
3. Illustrate the cost and energy saving areas, carbon reduction, energy management and monitoring

**Methodology**

1. Data gathering using laboratory experiments – use of Energy rating measuring equipment to record the energy consumption on different laboratory scenario.
2. Internet Research on manufacturers specifications and documents – check labels, product specifications at manufacturers website
3. Internet research on secondary data coming from published experiments, research and white papers.
4. Data interpolation, assumptions and analysis

**Limitations**

1. The use of statistical tools to have a more accurate data analysis is not employed in the experiment
2. Linear calculations are used, thus it may not be 100% precise but indicative readings are useful enough to assert some facts.
3. Biases of the author on certain products, technologies and personal experience.

**Disclaimer**

1. Brands and trademarks used in this paper are primarily used for illustration purposes only and do not intend to recommend or discredit any product available in the market today.
2. Author may be recommending or spousing certain technology that are proprietary to certain brands for purposes of semantics and terminology readily understandable to the readers, but does not necessarily endorse or discredit certain products or its counterpart.

**Equipment Measured and Compared**

1. Envir Energy Monitor
2. Web Client
3. Y210
4. Y100
5. WYSE
6. Server

**Data Collected for all the above devices**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | AND1 | Y210 | Y100 | Desktop | SERVER 1 | SERVER 2 |
| Off | 0.27 | 1 | 0.3 | 11 | 3.1 | 19 |
| Max Boot | 5.1 | 5 | 3.5 | 12 | 30 | 42 |
| Idle | 3.4 | 5 | 3.2 | 11 | 22 | 42 |
| Word | 5.1 | 5 | 3.3 | 12 | 24 | 44 |
| Excel | 5.1 | 5 | 3.3 | 12 | 24 | 44 |
| Browsing | 4.6 | 5 | 3.0 | 12 | 24 | 44 |

**Task and Activities**

1. **Negotiate with the stakeholders to establish the extent to which sustainability is to be integrated**

Answer:

**Stakeholders Analysis**

|  |  |  |
| --- | --- | --- |
| Stakeholders | Issues and Concerns | Response |
| Executives | Why fix it when it is not broke?  Risk and Business Impact | Computer devices has its own useful life or mean-time-before failure, end-of-life vendor support, thus it will definitely come to end. Replacing the infrastructure or architecture before it breaks reduces down time and bigger business impact.  The solution is a centralized computing; no information significant data/information at the user side will be at risk. |
| Finance Managers | Upfront cost, cost recovery mechanism | Initial cost or upfront cost maybe big but in the long run it will be a lot cheaper since it draws a little power, it has smaller footprints |
| IT administrators | Single point of failure, performance | This can be mitigated by adding redundancy, failover and hot standby |
| HR Managers | Learning curve, training and change management | The solution will leverage the existing user experience surfing the internet, may not be that long to understand as users are able to use the internet without formal training coming from website owners.  A video tutorials, webinars, and an online user guide will be made available |
| Uses | Performance, Quality of images, speed | Regular usage such as internet browsing, word processing and spreadsheet may not have a big difference but high resolution graphics and video images may impact the speed and performance of the machine |
|  |  |  |

**Hardware**

**Renewable Energy Source**

Research and specification regarding renewable energy source is not part of the of the scope but it is highly recommended to tap the widely available solar energy.

**Low powered hardware**

This clients used in this projects does not include hard drives and very minimal power requirements, all other devices are certified to be energy efficient.

2. Advise short term technology solutions to achieve reduction of power consumption

Answer:

1. Energy Monitoring and management, a good handle of how much power we are using is a good start to see the areas where we can reduce energy consumption without the need of replacing hardware. Proper management and monitoring of hardware to cut-down power consumption will help in the effort of achieving green IT
2. Use energy efficient hardware at the time of replacement of every devices, such monitors and printers.
3. LCD display are not of a focus of the proposed solution as it will still be used, but come replacement time, it is highly recommended to use energy efficient displays.

3. **Identify energy usage within the scope of the ICT project and provide a detailed report**

Answer:

|  |  |  |
| --- | --- | --- |
| Condition | Power consumption  (watts) | Notes |
| OFF | 0.27 |  |
| MAX BOOT | 5.1 |  |
| IDLE | 3.4 |  |
| Word-processing | 5.1 |  |
| Spread sheets | 5.1 |  |
| Web browsing  <http://news.bbc.co.uk/2/hi/programmes/click_online/default.stm> | 5 watts |  |
| Low level music  <http://grooveshark.com/#/s/Fall+At+Your+Feet/3KIZB0?src=5> | 5.2 |  |
| Low level video  <http://www.joost.com/39w1yk49/#/?video_info=33p1yw1t> | 6.7 |  |
| Monitor | 21 |  |
| Printing | 21 |  |

**Individual Report**

1. **Explain how sustainability can be integrated into your individual Project**

“Sustainability” can mean different ways depending on what aspect of technology and modernisation we are after to. In the perspective of Information technology, we aim to achieve solutions that would contribute the sustainability of energy sources and reduce the carbon emission in order to help the global effort of achieving a low carbon consumption ecosystem. Electronic devices are power consuming, carbon emission was already been there even from the time that every electronic device was designed and manufactured. But in today world, these devices are ubiquitous that almost every individual and business needs to be able to be productive and competitive.

It is given; we can’t do away with this power consuming devices. To be able to contribute the global effort in reducing the carbon footprints, designers, manufacturers and integrators must continue to innovate and look to solutions and technology that do the job using low power.

We aren’t designer or manufacturer of computing devices and electronic components utilizing power, but are the consumers, integrators and consultants that influence the decision makers in using these computing devise.

Having said that, IT Professionals, Engineers, Integrators and Consultant plays a vital role in the design, selection and utilisation of electronic devices be it energy efficient or not, if only we have a common goal and keep “Sustainability in Mind in all our projects, we will definitely contribute the carbon reduction advocacy.

In summary:

1. Use and promote the use of low power computing devices
2. Use and promote the use of Energy Efficient devices
3. Use and promote renewable energy sources when applicable
4. Use and promote energy monitoring devices.
5. **Research and identify suitable technology solutions applicable to the project (WEB CLIENT)**
6. AND1



 AND1 uses Dual core 1GHz Cortex A8 CPU, 512M bytes DDR2 400, 512M bytes Nand Flash, It embedded Android system.

|  |  |  |
| --- | --- | --- |
| **Software** | **Audio Player** | **Video Player** |
| Android market Google Maps /Google Talk/iReader/Google Search Android Word Excel PDF Reader/Photo Browser/Weather Forecast/QQ/Email/Gmail | MP3?WMA?APE?FLAC?OGG?WAV  Frequency response: 20Hz to 20000Hz | AVI, MKV(XVID/px/H.264), MOV, TS, M2TS, RM/RMVB, FLV, 3GP, MPEG, DAT, MP4    (support to 1080P) |

Internal HW   Dual core 1GHz Cortex A8 CPU, 512M bytes DDR2 400, 512M bytes Nand Flash, Embedded Android operating firmware

**HARDWARE:**

Size: Width:  115 mm/4.5 inches, Height:  26 mm/1 inches, Depth: 115 mm/4.5 inches

Weight    AND1 Access Terminal:  195 g / 0.45 lbs.

**Power Supply**

Input:  100-250 VAC, 50-60 Hz

Output:  5 VDC, 2 A

Nominal consumption: 5 W

**Front LED Indicators:**

Power:   connection to power supply

LAN:      connection to network

Ready:   connection to host PC"

Connection to Host PC       Unlimited distance via 100 Mb/s switched Ethernet connection

The thin client can work with both Static IP and Dynamic IP, can be used stand-alone; firmware supports remote update.

**Video Resolution:**

(4:3): 800x600, 1024x768, 1280x1024;

(16:9): 1280x720, 1366x768;

(16:10): 1440x900;

Color Depth: 32-bit

Audio     16-bit stereo output via speaker port

**USB Flash Memory Port**     USB2.0 x 4, to support USB memory devices-requires Windows OS on host

**Reliability (MTBF)**       >100,000 hours (calculated using Bellcore Issue 6 TR-332, Case 2, Part I at 40 degree)

**Benefits:**

* Lower Noise
* Easier to maintain
* Enhanced Data Security
* Lower Hardware Costs
* Less Network Bandwidth
* Less Wasted Hardware
* Lower IT maintain Costs
* Simple Hardware Update
* Easier Hardware Failure Management
* More Efficient Use of Computing Resources
* Less Energy Consumption (under 5 watts per user)

Suitable and especially for: Office, call center, training center, factory, school, coffee, government, library,Hospital,Family,Hotel etc.

**Kit Contents**  
RFX10 Kit includes access terminal, power supply/cord, software installation & user guide CD and monitor mounting bracket.

PC, monitor, USB keyboard, USB mouse, speakers and other peripherals are NOT included and must be purchased separately.

<http://www.ywterminal.com/en/product.asp?id=101>

Dell T320

|  |  |
| --- | --- |
| Chassis Configuration | Chassis with up to 4, 3.5" Cabled Hard Drives and Embedded SATA |
| Processor | Intel® Xeon® E5-1410 2.80GHz, 10M Cache, Turbo, 4C, 80W, Max Mem 1333MHz |
| Memory Configuration Type | Performance Optimized |
| Memory DIMM Type and Speed | 1333 MHz UDIMMs |
| Memory Capacity | 4GB UDIMM, 1333 MT/s, Low Volt, Dual Rank, x8 Data Width |
| Operating System | No Operating System |
| OS Media Kits | No Media Required |
| RAID Configuration | No RAID with Embedded SATA (1-4 SATA HDDs) with Cabled Chassis |
| Hard Drives | 500GB 7.2K RPM SATA 3.5in Cabled Hard Drive |
| Embedded Systems Management | Basic Management |
| Add-in Network Adapter | On-Board Dual Gigabit Network Adapter |
| Power Supply | Single, Cabled Power Supply , 350W |
| Power Cords | NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord |
| Power Management BIOS Settings | Power Saving Dell Active Power Controller |
| Rack Rails and Casters | Tower Chassis, No Casters |
| Internal Optical Drive | No Internal Optical Drive |
| System Documentation | Electronic System Documentation and OpenManage DVD Kit |
| Hardware Support Services | 3Yr Basic Hardware Warranty Repair: 5x10 HW-Only, 5x10 NBD Onsite |
| Cost | AUD 1,366.00 |

Full Specification can be found at

<http://i.dell.com/sites/doccontent/shared-content/data-sheets/en/Documents/T310-SpecSheet.pdf>

Energy Star Rating

<http://i.dell.com/sites/doccontent/business/large-business/en/Documents/29-Dell-PowerEdge-T310-1P-X3430-400W-Energy-Star-Data-Sheet.pdf>

<http://www.dell.com/downloads/global/corporate/environ/comply/pedge_t310.pdf>

|  |  |  |
| --- | --- | --- |
| **Hardware** | **Cost(AUD$)** | **URL** |
| Dell PowerEdge T310 | $1,649.00 | <http://configure.ap.dell.com/dellstore/config.aspx?oc=t420901au&model_id=poweredge-t310&c=au&l=en&s=bsd&cs=aubsd1> |
| Pro Safe TM 24 Gigabit Rack mount Switch (JGS524) | $299.99 | <http://www2.netgear.com.au/au/Product/Switches/Unmanaged-Rackmount-/JGS524> |
| AND 1, $100 | $2,000 | <http://www.ywterminal.com/en/product.asp?id=101> |
| N900 Wireless Dual Band Gigabit Router with USB | $259.00 | <http://accessories.ap.dell.com/sna/productdetail.aspx?c=au&l=en&s=dhs&cs=audhs1&sku=A6053362&~ck=baynoteSearch&baynote_bnrank=0&baynote_irrank=0> |
| Dell v725w All in one Wireless Inkjet Printer | $152.00 | <http://accessories.ap.dell.com/sna/productdetail.aspx?c=au&cs=audhs1&l=en&sku=210-39218> |
| HP W2072a 20 Diagonal LED backlit LCD  Monitor (A3M50AA) | $199.00x21 | <http://www8.hp.com/au/en/products/monitors/index.html> |

1. **Explain the power consumption data compared to benchmarks**

The power rating provided in the product specification sheet is almost the same as that of the reading we got in the experiment. 0.1 watt difference could mean a lot of things, there are other variables to consider like the measuring instrument, other devices attached to the device drawing power from the AND1 machine. Thus the 0.1 difference could be considered negligible.

1. **Advise how sustainable management principles may be applied to your individual project resulting in reduced environmental impact.**

As shown in the resulting data from the experiment, it shows that, thin-client computing using web client device are energy efficient compared to traditional desktop, the energy consumption and carbon emission will help in the global effort to reduce carbon footprint.

There could even be more energy savings if we use energy efficient devices, monitor and control the devices using software that alerts administrators.

1. **Provide key performance indicators (KPI) - sustainability performance for your individual Project**

**Key Performance Indicators**

|  |  |  |  |
| --- | --- | --- | --- |
| Hardware | SD-KPI 1: Energy / greenhouse gas efficiency of production / products in use  (tons CO2) | SD-KPI 2: Proportion of products with “Design for Environment” / Eco-Label  (√)  or (x) | SD-KPI 3: Emissions of (hazardous) waste and toxic materials  Yes or No |
| Server | .045 x 24 x 365 x6.89560/10000 = 0.271824552 | Yes | Yes |
| Switch Port | 0.008x24x365 x6.89560/10000=0.048324 | Power consumption automated based on length of power lead and cables connected.  Reference from tp-link.com/lk/products | ROHS = yes |
| Thin client x 20 | 0.005x8x262 x6.89560/10000=0.007  Total = 0.1445 (for 20 ) | No Logo | No Logo |
| Modem/Router  (Netgear) | 0.007x24x365 x6.89560/10000=0.042283 | Netgear green logo refers to website. | No |
| Monitor | 0.016x24x365 x6.89560/10000= 0.096648 | Yes = EPA Energy Star symbol (on the box) | No |
|  |  |  |  |

1. **Advise what actions could improve the KPI’s for your Individual Project which foster sustainability and environmental best practice**

The computations presented in this project was based on the available resources to test and measured, to further improved the KPI it is recommended to use products that would fit the following requirements

1. Low Power consumption
2. Designed for Environment
3. ROHS compliant
4. **Evaluate the estimated CO2 emissions with comparable benchmarks; and**

With the global effort to cut-down CO2 emissions, manufacturers are becoming more and more efficient in design in compliance with energy rating standards. Generally, newer computing devices offers 40%-60% energy savings. In the case of this project, traditional desktop tested offers 22w consumption while Android desktop only consumed 5 watts.

1. **Estimate the carbon dioxide (CO2) emissions for the Individual Project; and Individual Project + Recommended Actions**

|  |  |  |  |
| --- | --- | --- | --- |
| Hardware | Benchmark  (tons CO2) | Individual Project  (tons CO2) | Individual Project  +  Recommended Actions  (tons CO2) |
| Server | .450x24x365x6.89560/10000  = .2711824552 | = .2711824552 | = .2711824552 |
| AND1 | 0.005x262x6.89560/10000  =0.009033236 | =0.009033236 | =0.009033236 |
| Printer | 0.016x24x365x6.8955/10000  =0.096648 | =0.096648 | =0.096648 |
| Monitor | 0.018x24x365x6.89560/10000  =0.108729820 | =0.108729820 | =0.108729820 |
| Switch | 0.016x24x365x6.89560/10000  =0.096648 | =0.096648 | =0.096648 |

1. **Make recommendations in order of priority and give estimates of implementation costs on integration of sustainability for other ICT projects;**
2. Use of Energy Start compliant monitors/ displays
3. Use of low power clients

1. **Estimate potential energy savings and payback periods for recommended actions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Recommendation | Priority | Implementation Cost | Energy Saving | Payback Period |
| Energy Star Compliant Monitors | 1 | 4,179 | 30% - 40% | 1 year |
| Low Power Clients | 2 | 2,000 | 60-75% | 6 months |

**Future Trends**

# $49 Android PC System

APC was not built like an ordinary PC. For openers, we started with an awareness that the purpose of a computer is to connect to the Internet. It is the Internet that now defines computing. When you begin here, magic happens.

Expensive, overpowered CPUs and bloated software are no longer relevant. With this awareness, we were able to drop power consumption to the point of making an energy-saving light-bulb jealous.

## Technical Details

APC runs a custom Android system, built for keyboard and mouse input. A basic selection of applications is preinstalled. Also included is a full set of consumer I/O ports, enabling APC to connect to your PC monitor or TV.

| **Item** | **Description** |
| --- | --- |
| Model | APC 8750 |
| Software | Android 2.3 (PC System) |
| Chip | VIA 800MHz Processor |
| Memory | DDR3 512MB Memory  2GB NAND Flash |
| Graphics | Built-in 2D/3D Graphic  Resolution up to 720p |
| Input and Output | HDMI VGA USB 2.0 (x4) Audio out / Mic in  microSD Slot |
| Network | 10/100 Ethernet |
| Size | 170 x 85mm (W x H)  Neo-ITX Standard\* |

1. http://shop.bsigroup.com/en/Browse-by-Subject/Green-IT/ [↑](#footnote-ref-1)